

Impaction status of third molars in Jordanian students

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The status of third molars was studied radiographically in 108 male and 124 female Jordanian students (mean age, 20.4 years). The results showed that 9.1% of third molars were congenitally missing. Approximately 73% of the subjects had all four third molars, 12% had three third molars and 11% had two third molars. Only 1.7% had agenesis of all third molars. Third molar agenesis showed predilection for the maxilla over the mandible. There was no significant sexual dimorphism in the agenesis of third molars. Impaction of third molars was found in one third of the subjects with predilection (5.2%) to the maxilla. The proportion of impaction in males was 17.4% and in females 16.2%. Angular position of mandibular third molars revealed that half of the teeth were mesially tilted (average angle $20 \text{ degrees} \pm 13 [\text{SD}]$ and 41% were in vertical position. A highly significant correlation ($r = 0.79, p < 0.001$) in the inclination angles was observed between the right and left side of the mandible. The level of eruption of third molars showed 58% of the teeth were fully erupted to occlusal plane, whereas 26% were embedded below the cervical line of adjacent second molar (level C). Males showed a significantly higher frequency ($p < 0.001$) of level C eruption than females. Results indicated that 11.6% of the subjects or 8.4% of the third molars had incomplete root formation, of which two thirds to one thirds root completion was at a ratio of 4.3:1. The clinical significance of these results is discussed. (ORAL SURG ORAL MED ORAL PATHOL ORAL RADIOLOG ENDOD 1995;79:24-9)

The presence or absence of third molars (M3), the age at which they develop, time of eruption, position, and direction of eruption are relevant to every branch of dentistry. Surveys of the prevalence of impacted M3 in the population of different countries and races are relatively rare. Mead¹ reported that 18.8% of his office patients had at least one impacted tooth. Hellman² who examined 433 students at Columbia University found an incidence of 15.2%, with females twice as likely to have an impaction as males. Dachi and Howell³ examined 3874 patients and found that 29.9% of the maxillary M3 and 17.5% of the mandibular M3 were impacted but found no sex difference. Kramer and Williams⁴ surveyed a black population and found the incidence of impaction to be 18.2%. They also found that M3 were more often impacted in the maxilla than in the mandible, but there was no sex difference. Studies in Scandinavian communities revealed that the proportion of persons with impaction of M3 varies from 19 to 35%.⁵⁻⁸

The stage development of the M3 has been investigated by several authors.⁹⁻¹² Banks⁹ reported that M3 crypts appeared between 5 and 14 years of age and that 7 to 9 years are needed for complete development. Adamson¹⁰ stated that M3 crypts do not ap-

pear until 9 to 10 years of age, whereas Garn et al.¹¹ reported that most M3 crypts appear at the age of 8 years. In a recent study, Gorgani et al.¹² reported that by the age of 10 to 11 years, 90% of the M3 were visible on panoramic radiographs. One is tempted to deduce that the earliest age at which M3 are radiographically apparent is 8 to 10 years, and their crown calcifications are completed at the age of 14 to 15 years. Richardson¹³ indicated that if M3 formation is delayed beyond the age of 10 years, the possibility of all M3 developing is reduced by about 50%.

Agenesis of one or more M3 vary substantially in persons from different races, with prevalence of approximately 1% in African Negro and Australian aboriginal samples,¹⁴ 10% to 25% in whites,^{9-12, 14, 15} 19% to 35% in Scandinavians,^{8, 16} and 30% in Japanese¹⁷ and Chinese.¹⁸ Levesque et al.¹⁹ reported 9% (422 persons of a total 4640) bilateral agenesis of mandibular M3, without significant difference in sex distribution. Gorgani et al.¹² found that the rate of agenesis of M3 for black and white population ranged from 7% to 10% with bilateral agenesis occurring in 79% of the sample.

Times of eruption of M3 are also variable starting at the age of 16 years; averages of 17.8,¹⁰ 19.0,¹⁹ 20.5,²⁰ and 24²¹ years have been reported. Earlier eruption of third molars was reported among rural Nigerians, that is, by age of 13 years for females and 15 years for males.²² In most of these studies, however, the criteria used for eruption was the emergence of any portion of the crown through the oral mucosa. This may give misleading results because

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Table I. Number of third molars per person

Sex	Number of third molars					Total
	Four	Three	Two	One	None	
Male	73 (67)	17 (16)	13 (12)	3 (3)	2 (2)	108
Female	96 (77)	10 (8)	12 (10)	4 (3)	2 (2)	124
Total	169 (73)	27 (12)	25 (11)	7 (3)	4 (2)	232

Table II. Angular position of mandibular third molars

Sex	Angular position				Total
	Vertical	Mesioangular	Distoangular	Horizontal	
Male	61 (34%)	97 (54%)	8 (4%)	12 (7%)	178
Female	82 (44%)	85 (46%)	11 (6%)	7 (4%)	185
Total	143 (39%)	182 (50%)	19 (5%)	19 (5%)	363

many of the M3 do not continue to erupt but remain impacted in a partially erupted position.²³

It is generally accepted that patterns of facial growth, jaw, and tooth size are inherited and are likely to differ among populations and races. To date no information is available on the status of M3 in Jordanians and very little data are available on the Arab populations in general. The aim of the present study was to assess the prevalence of agenesis and impaction, position, and level of eruption of M3 in Jordanian university students.

MATERIAL AND METHODS

The population studied was 232 university students seen in the Department of Oral Radiology, Jordan University of Science and Technology, Irbid, during the years 1989 and 1990. Subjects receiving orthodontic treatment were excluded from the survey as well as those who had any of the posterior teeth, excluding M3, extracted. At the start of the study the mean age of the subjects was 20.4 years (range, 18.2 to 23.5 years). Sex distribution was 108 males (47%) and 124 (53%) females. Panoramic radiographs and case notes were taken for each subject. The radiographs were examined for the following: (1) number of M3 per person; (2) prevalence of impaction and angular position; (3) level of eruption; and (4) root development.

For the purpose of this study, M3 was deemed to be impacted when its complete eruption to occlusal height was prevented or blocked by an adjacent tooth. M3 impaction was classified radiographically according to the state of eruption in two categories: (1) erupted (partly or completely erupted), the highest portion of the tooth was above the cervical line of ad-

jacent second molar (M2); (2) nonerupted (bony or soft tissue impaction) but with complete root formation. Impacted M3 were also grouped according to their position including: vertical, mesioangular, distoangular, and horizontal. Nonerupted M3 with incomplete root formation were not included in the group of impacted teeth because eventual eruption is uncertain.

ANGULAR POSITION

The angular position of the mandibular M3 was determined from a tracing of the panoramic radiographs. A line was drawn through the midpoint of the occlusal surface and bifurcation of the M2 and the M3. These lines represent the long axes of the teeth. The angle formed between the intersected long axes gave either a mesial or distal inclination of M3 in relation to M2. Inclination angle was then read from a compass grid drawn on transparent film with the use of a radiographic view box. The inclination angle was then read in increments of 5 degrees to a maximum of 65 degrees, above which the M3 were considered to be horizontally impacted.

LEVEL OF ERUPTION

Maxillary and mandibular M3 were grouped according to depth by their relationship to the cervical line of adjacent M2. In level A, the highest part of the M3 was on the same level or above the occlusal plane of adjacent M2. In level B, the highest part of the M3 was below the occlusal plane but above the cervical line of the M2. In level C, the highest part of the M3 was beneath the cervical line of the M2. All erupted and impacted M3 were registered except the unerupted M3 with incomplete root formation.

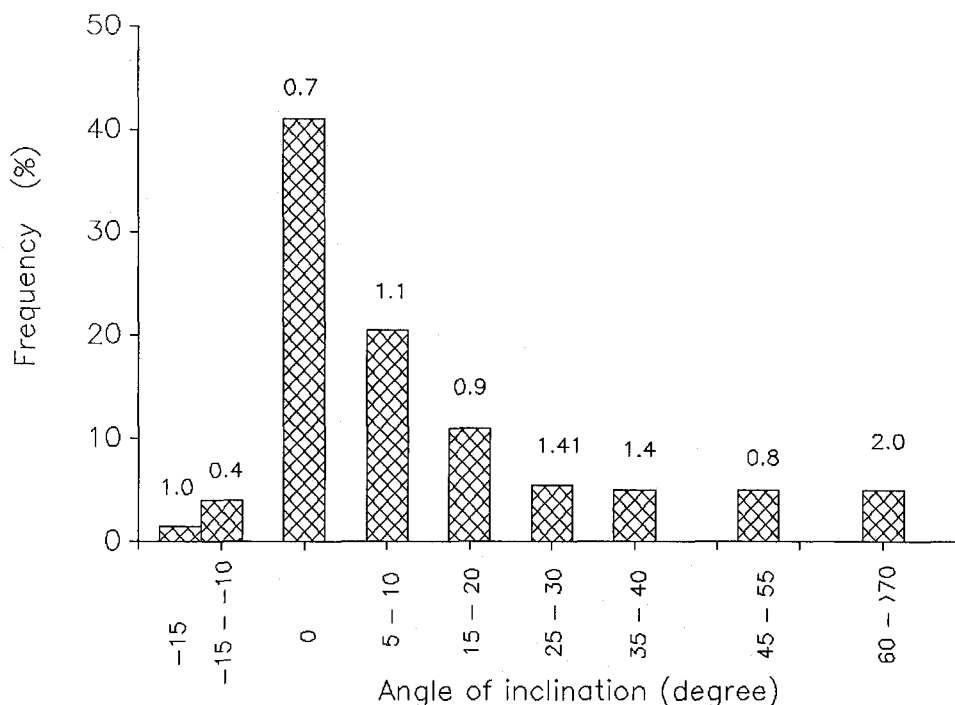


Fig. 1. Frequency (in percentage of total sample) of angles of tilt (in degrees) of mandibular M3 measured and grouped in 5 degree increments. Readings above 45 degrees were grouped at 10 degree intervals. The values at top of histograms denote male to female ratios.

ROOT DEVELOPMENT

The maxillary and mandibular nonerupted M3 were classified according to the stage of root formation, namely, completed or noncompleted. The non-completed were divided into one third or two third complete formation.

RESULTS

The number of M3 per person is presented in Table I. The age distribution of the subjects was fairly close and within a narrow range. The number of M3 found in 232 subjects was 814; 412 teeth were in the upper jaw and 402 teeth in the lower jaw. The number of missing M3, including those lost through extraction, was 114 (12.3%). The proportion of M3 agenesis was 9.1%, whereas the rate of teeth lost through extraction was 3.2% (30 teeth of a total 928). Table I also reveals that 72.8% of the subjects had all four M3, 11.6% had three M3, and 10.8% had two M3. Only 1.7% of the subjects had agenesis of all M3. The proportion of M3 agenesis for males was higher (3.3%) than that for females; the difference was not significant. Congenitally missing M3 showed a predilection for the maxilla over the mandible. The number of subjects that had the both upper M3 congenitally missing was 14 (6%), where-

as 8 (3.4%) of the subjects had bilateral agenesis of the lower M3. M3 agenesis showed an equal distribution between the right and left side of both jaws.

Of 232 subjects, 78 (33.6%) had one or more impacted M3. The proportion of impaction in males was 17.4% and in females 16.2%. When the data were calculated on the basis of teeth samples, 28.2% (194 teeth of a total of 688) of M3 were found to be impacted. The frequency of impaction in the maxilla was 52.6% and in the mandible 47.4%.

The angular position of lower M3 is presented in Table II. Grouped measurements of the angles of tilt at 5 degree intervals and their ratios in males to females are shown in Fig. 1. Half of the teeth were mesially tilted in relation to the second molar. Males showed a higher frequency (8%) of mesial inclination than females. Vertical position was second in frequency, representing 41%. Of the 363 teeth, 19 (5.2%) were either distally tilted or horizontally impacted. The inclination angle of mesially tilted M3 averaged 20 degree \pm 13 degree (SD) in males and 19 degrees \pm 13 degrees (SD) in females. The angle of distally inclined M3 averaged 10 degree \pm 4 degree in males and 8 degree \pm 4 degree in females. Pearson's correlation coefficient was applied to find the rela-

tionship between left and right inclination angles. A highly significant correlation ($r = 0.79$, $p < 0.001$) was obtained.

The level of eruption of M3 is shown in Table III. Of the 688 teeth, 399 (58%) were positioned with their occlusal surfaces on the same level or above the occlusal plane of the adjacent M2 (level A). Females demonstrate a higher frequency (9%) of level A eruption than males. The maxilla is predominant site (226 teeth) over the mandible (173 teeth). The difference was statistically significant ($p < 0.05$, $\chi^2 = 7.03$). Level B eruption was the least frequent in occurrence among the other levels of eruption (Table III). Females had 4% more M3 at level B eruption than males. Level B eruption showed a higher frequency in the maxilla (61 teeth) than in the mandible (46 teeth). The difference was not statistically significant. One hundred eighty M3 (26.2%) were erupted to level C. The proportion of level C eruption in males was higher (13.1%) than in females. The difference was highly significant ($p < 0.001$, χ^2 test). Level C eruption occurred more frequently in the maxilla than in the mandible at a ratio of 1.3; however, the difference was not statistically significant.

The development of roots was assessed in unerupted maxillary and mandibular M3. Only cases in which all existing M3 had incomplete root formation were included. Of 232 subjects, 27 (11.6%) had incomplete root formation. This corresponds to 8.4% (68 of 814) of the total number of teeth examined. The ratio of two thirds to one third root completion was 4.3. One fourth of the unerupted M3 showed incomplete root formation. There was a tendency for more frequent incomplete root formation in males than females.

DISCUSSION

Third molars are the teeth that are most often congenitally missing. If present, M3 may follow an abortive eruption path and become impacted as a result of the skeletal insufficiency in the area where they normally erupt. Impacted M3 are developmental pathologic medical deformities characteristic of a modern civilization. They account for 98% of all impacted teeth.²⁴ The cause of agenesis of one or more teeth is essentially unknown, but several mechanisms have been suggested: physical disruption of the dental lamina, space limitation, and an inherent defect of the dental lamina or failure of induction of the underlying mesenchyme. Space limitation and crowding is particularly involved in the agenesis of M3, where competition for minimum nutritional requirement in a spatially constricted area can cause tooth germ regression and agenesis.¹⁴ In general, these changes are under the influence of genetic and environmental fac-

Table III. Level of eruption of maxillary and mandibular third molars

Sex	Level of eruption			Total
	A	B	C	
Male	165 (53%)	43 (14%)	104 (33%)	312
Female	234 (62%)	66 (18%)	76 (20%)	376
Total	399 (58%)	109 (16%)	180 (26%)	688

tors. There is no known association of agenesis of only the M3 with syndromes. On the other hand, impaction of M3 occurs as a result of retardation of facial growth, shortage of space in the M3 region, vertical direction of the condylar growth associated with low resorption of the anterior border of the ramus, the distal direction of the eruption of the other teeth, low mandibular growth rate resulting in a reduction in the length of the jaws, early physical maturity, and late M3 mineralization.^{5, 25-27} The growth of the maxilla and mandible is essentially completed by 16 to 17 years of age.

The mean age of participants in the present study (20.4 years) is very close to the average age of 20.3 years reported for the eruption of M3.^{2, 11, 19, 21} Schersten et al.⁸ suggested that 20 to 25 years is the most suitable age for studying the frequency of M3 and its impaction. The reason for this is to avoid overestimation of M3 agenesis as a result of unnoticed early extraction in older group. Further, many impacted M3 can change their position and erupt after the age of 18 to 20 years.^{23, 28-30} This indicates that the eruption period for M3 is longer than supposed previously.

Results of the present study showed that about three quarters of the subjects had all four M3. This proportion is higher than Hellman² found with American students and Schersten et al.⁸ with Scandinavians, who also noted that one half of the persons had all four M3. Our observation that 9.1% of M3 are congenitally missing is in agreement with the data reported by Levesque et al.¹⁹ for French-Canadians, Gorgani et al.¹² for American whites, and Haidar and Shalhoub³¹ for the Saudi population but one half the prevalence reported by Pogrel³² for orthodontic patients. In the present study, 1.7% had agenesis of all M3. This observation is considerably less than that for the Scandinavian population (10% to 13%)^{5, 8, 16} and the Americans (7% to 10%).¹² According to Banks,⁹ it is most common for two M3 to be missing, followed by one, four, and three. On the contrary, we found the order of frequency for missing teeth is one, two, three, and four, which is in agreement with the frequency noted by Nanda.³³ The proportion of M3 agenesis for

Jordanian females was less than males, but the difference, unlike the sample of Thompson et al.¹⁵ was not significant. In this context, our findings are in agreement with those reported by Levesque et al.¹⁹ and Gorgani et al.¹² but differ from those of Hellman² and Shah et al.,³⁴ who found that females had a higher incidence of M3 agenesis. Results of the present study agree with earlier reports^{1, 3, 4, 16} that maxillary M3 were more commonly missing than mandibular M3. Equal distribution between the left and right side as noted by Hellman,² Grahnen,¹⁶ and Shah et al.³⁴ is confirmed in our study.

In the present study, one third of the persons had had one or more impacted M3. This figure is considerably higher than that reported by Shah et al.³⁴ (6.9%) for Canadian population and about 13% higher than the average of 20% presented by some studies in the United States.¹⁻⁴ but in agreement with Scandinavian data (29% to 35%).^{5, 7, 8} Our results showed no sex differences in the prevalence of M3 impaction. This differs from the observation made by Hellman² and Schersten et al.⁸ but is in agreement with the observation made by Dachi and Howell³ and Kramer and Williams.⁴ The lack of definite sex predominance in the M3 impaction raised the question against Hellman's² statement that the jaws of females stop growing when M3 just begin to erupt, whereas, in males, the growth of the jaws continues beyond the time of eruption of the M3. Our observation that the maxilla showed a greater tendency for occurrence of M3 impaction than the mandible (52.6% versus 47.4%) is in the general line, but less in magnitude, than those reported by others.²⁻⁴

The angulation of the M3 may influence their subsequent eruption and therefore impart clinical significance on the state of M3. Altonen et al.²⁷ found that the angulation of the lower M3 in relation to M2 decreased with age especially after 14 to 15 years of age. Richardson²⁵ reported that M3 with a small degree of angulation erupted earlier than those with steeper angulation.

Longitudinal studies on the positional changes and eruption of M3 demonstrate that many unerupted, partially erupted, or impacted M3 are likely to change their position and erupt after the age of 20 years and that their final state remains unpredictable.^{23, 28-30} It has been speculated that the M3 have a constant path of eruption until contact is made with adjacent teeth. At that stage they upright themselves as the result of a "billiard ball action."³⁵

The present study showed that one half of the mandibular M3 were in mesioangular position (Table II). This number is considerably higher (18%) than that reported by Sewerin and von Wowern,²⁸ but

similar in proportion to that noted by Richardson³⁰ for persons aged 21 years. Our observation that 39% of the M3 were in vertical position is less than that reported by others.^{29, 30} The frequency of distoangular impaction in the present study was much less (4.4-fold) than of Sewerin and von Wowern,²⁸ but the rate of horizontally positioned M3 was similar. Of the mesioangular teeth, 72% were inclined mesially up to 25 degrees (Fig. 1), and many of them may change their position and erupt after the age of 20 years.³⁰⁻³² In our study, 194 impacted M3 were found in 232 persons, a ratio of 0.8 impacted tooth per person.

CONCLUSIONS

Based on the data collected, the following conclusions can be drawn:

1. Of the theoretical total M3 (928 teeth), 9.1% (84 teeth) were congenitally missing. The order of frequency for missing M3 is one, two, three, and four.
2. Of 232 subjects, 72.8% had all M3, 11.6% had three M3, and 10.8% had two M3. Only 1.7% had agenesis of all M3.
3. Impaction of M3 was found in 33.6% of subjects or 28.2% of the M3 present. The ratio of impacted M3 per person was 0.8.
4. The rank order for angular position of mandibular M3 is mesioangular (50%), vertical (39%), distoangular (5%), and horizontal (5%).
5. In this material 58% of the M3 were fully erupted.

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